Basic Units of Lexicons and Ontologies: Words, Senses and Concepts[*]

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Abstract. Dictionaries and ontologies are very important resources not only for linguistic research and applications but also for other areas dealing with knowledge. In general, however, they fall short of our expectations. One reason for this under-expectation is that their basic units are not well-established. Dictionary head words have to be words rather than affixes or phrases. The meaning of a (head) word has to be carved into different senses on the basis of objective criteria. In addition, building blocks of ontologies have to be (simple and/or complex) concepts rather than senses.

Keywords: Lexicons/Dictionaries, Ontologies, Head words, Senses, Concepts.

1   Introduction

Lexicons/Dictionaries have been one of the most important resources for linguistic research and applications. Ontologies are also becoming an indispensible resource not only for linguistics but also for other areas dealing with knowledge. In many cases, however, they fall short of our expectations. One reason for this under-expectation is that their basic units are not well-established. There are two kinds of basic units of dictionaries: head words and (word) senses. It is a truism that head words have to be words rather than affixes or phrases. However, it is not always true that only word units are registered as head words, especially in the dictionaries of agglutinative languages. In addition, the meaning of a word has to be carved into different senses on the basis of objective criteria. On the other hand, building blocks of ontologies have to be (simple and/or complex) concepts rather than senses.

In section 2, we will evaluate the morpho-syntactic status of head words in a Korean dictionary. It will be shown that many head words are phrases and, hence, have to be removed from the list of head words. In addition, many elements that are treated as affixes are actually words and, hence, have to be registered as head words. We need to realize that agglutinative languages like Korean have many clitics, i.e. (syntactic) words which have some affixal properties as well. In section 3, we will consider issues related to polysemy. We need to distinguish between homophony and polysemy, on the one hand, and between polysemy and vagueness, on the other. Lastly, in section 4, we will consider basic units of ontologies. Some scholars argue that they have to be word senses rather than concepts. However, many scholars assume that they have to be concepts rather than senses. We will show, based on a variety of phenomena, that the building blocks of ontologies should be concepts.

2   The Morpho-syntactic Status of Dictionary Head Words

Basic building blocks of dictionaries are their head words. It is rather simple to identify word units in such inflectional languages as English. However, the task is not so easy in such

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agglutinative languages as Korean. One reason for this difficulty lies in the fact that Korean has various types of "little words/particles" which are dependent on other elements phonologically but should be analyzed as words syntactically. These particles are called "clitics," i.e. "grammatical units with some properties of inflectional morphology and some of independent words" (Zwicky 1977, Zwicky & Pullum 1983, Zwicky 1985, etc.). Although clitic elements abound in Korean (Kuh 1988, Chae & No 1998, Chae 2005, Chae 2007), traditional approaches have not given due attention to their existence. Consequently, many (clitic) words have not been considered as head words.

In general, multi-morpheme words are composed of roots, derivational affixes and/or inflectional affixes, and have a morphotactic structure of the following:

(1) inflectional prefix - derivational prefix - root - derivational suffix - inflectional suffix

Derivational affixes are positioned inside of inflectional affixes. In Korean, however, many elements which are neither derivational affixes nor inflectional affixes can also be parts of those composite words (Chae 2007: 805):

(2) a. [sensayng-nim -tul]-hanthey-man-un
       teacher   Hon Pl   to   only Top/Contr 'only to the teachers'
    b. [cap   -hi -si -ess -keyss   -ta] -ko   -yo
       catch Pass Hon Past Modality Decl IQuot Hon
       '(It is said) that he (Hon) might have been caught.'

In these examples, [*sensayng-nim-tul*] and [*cap-hi-si-ess-keyss-ta*] consist of roots (*sensayng* and *cap-*), derivational affixes (*-nim* and *-hi*) and inflectional affixes (*-tul, -si, -ess, -keyss* and *-ta*), which can be safely assumed to be word-internal elements. However, the elements outside the brackets can hardly be analyzed as either derivational or inflectional affixes.

Chae (2007) defines the elements outside the brackets in (2) as clitics, which have properties of both inflectional affixes and independent words. Depending on whether they have more properties of inflectional affixes or of independent words, clitics can be divided into several subtypes (Nevis 1985, Nevis et al. 1994):

(3) Phrasal Affixes / Edge Affixes - Bound Words - Obligatory Leaners

As for the clitics in Korean, case markers can be defined as phrasal affixes (Chae 1991/2000), and postpositions and delimiters are generally analyzed as bound words, i.e. typical clitics.

Since clitics are not phonologically independent, we can easily distinguish them from regular independent words. However, it is not so easy to distinguish clitics from affixes, because both of them are dependent on other elements. Zwicky & Pullum (1983) provide a list of differences between word-clitic combinations and stem-affix combinations. The main cause for these differences is that the former, as a combination of two (syntactic) words, are governed by syntactic principles, whereas the latter, as words consisting of word-internal morphemes, are by morphological/lexical principles. Based on this fact, Chae (2007: 809) proposes that clitics, compared with affixes, can be characterized as having the following properties:

(4) a. Have higher productivity than affixes in combining with preceding elements.
    b. Combine with phrases or clauses rather than word stems.
    c. Whose preceding elements themselves can be modified by other phrases.

The "preceding elements" in (c) indicate the "hosts" of clitics. These properties of clitics will be used as main criteria for distinguishing clitics from affixes when we are going to analyze a

string of multiple elements in Korean.

Under the framework of Chae (2007), Baik & Chae (2010b) and Chae & Baik (2010) evaluate the morpho-syntactic status of nominal entries and predicative entries, respectively, of a representative medium-size Korean dictionary, i.e. *Yonsei Korean Dictionary*. We found out two types of problematic cases. Firstly, many phrasal elements are wrongly registered as headwords. Secondly, some elements are not registered as headwords because they are wrongly analyzed as affixes.

Among the nominal and predicative headwords of the dictionary, many entries like the following have to be analyzed as regular phrases:

(5) Regular Phrases as (Wrong) Headwords: Nominal Entries
    a. Nouns: *kalwu-yak* ('powdered medicine'), *kaltay-path* ('a field of reeds'),
          kacwuk-os ('leather garments'), *tol-kyeytan* ('a stone stairway'), …
    b. Pronouns: *ku-kes* ('that thing'), *ku-pwun* ('that person[Hon]'), *ku-ccok* ('that side'), …
    c. Numerals: *kwu-sip* ('ninety'), *payk-man* ('one million'), *sa-sip* ('forty'), …

(6) Regular Phrases as (Wrong) Headwords: Predicative Entries
    kakong-hata ('to process'), *sonsang-toyta* ('to be damaged')
    nonuy-hata ('to discuss'), *paltal-toyta* ('to be developed')
    talseng-hata ('to achieve'), *swupan-toyta* ('to be accompanied by')
    myencey-hata ('to discharge'), *panip-toyta* ('to be brought in')

Although these entries are regarded as compounds and are listed as headwords, they cannot be compounds. First of all, extra materials can be inserted between the two component words concerned. In addition, unlike real compounds, each of the component words can be modified by other expressions. These facts show that they are just phrases, which cannot be regular headwords.

Among the headwords consisting of an independent word and a clitic word, some contain the clitic in the final position. This group of clitics is wrongly treated as (derivational) suffixes in the dictionary.

(7) Clitic-final Phrases as (Wrong) Headwords: Nominal Entries
    *kenchwuk-**ka*** ('an architect'), *kosotuk-**chung*** ('people in the high-income brackets'),
    *yeyswul-**kwan*** ('one's view of art'), *cekaypal-**kwuk*** ('an underdeveloped country'), ...

(8) Clitic-final Phrases as (Wrong) Headwords: Predicative Entries
    *ansengmacchwum-**ita*** ('be suited'), *kanan-**ha**ta* ('be poor'), *ancen-**ha**ta* ('be secure'),
    *namca-**tap**ta* ('be manly'), *chelthong-**kath**ta* ('be impenetrable')

Some others contain the clitic in the initial position. This group of clitics is wrongly analyzed as (derivational) prefixes in the dictionary.

(9) Clitic-initial Phrases as (Wrong) Headwords: Nominal Entries
    ***ka**-kyeyyak* ('a provisional agreement'), ***kwu**-ceyto* ('the old system'), ***ki**-sip (man wen)*
    ('hundreds of thousands won'), ***nal**-sayngsen* ('raw fish'), ***no**-kyoswu* ('an old
    professor'), ***ta**-mokcek* ('multi-purpose'), ***pan**-man (nyen)* ('five-thousand years'), ***pem**-*
    sahoycek ('pan-national'), ***pi**-sayngsancek* ('unproductive'), ***swu**-chen (kay)* ('several
    thousand pieces'), …

(10) Clitic-initial Phrases as (Wrong) Headwords: Predicative Entries
    a. pis-: ***pis**-kita*, ***pis**-nakata*, ***pis**-tayta*, ***pis**-macta*, ***pis**-mekta*

b. say-: **say-kkamahta, say-ppalkahta, say-phalahta, say-phalaycita, say-**hayahta
c. yek-: **yek-**sencen (hata/toyta), **yek**-iyong (hata/toyta)

The clitic words in (9) come before nouns and modify these nouns and, hence, can be categorized as adnominals. Those in (10) have the function of modifying the following verbs and, hence, can be categorized as adverbs.

In this section, we have seen that there are many phrasal entities which are wrongly registered as headwords in the dictionary. One obvious problem of such a system is that all the lexical entries involved have to be registered twice, leading to a significant amount of redundancy. For example, although *kakong-hata* (cf. (6)) is registered as a headword, we have to register *kakong* and *hata* as well. Notice that these words appear independently in such phrases as [*kakong cal hata*], in which the adverb *cal* 'well' is in between the two elements. There is a more serious problem. We would not be able to capture the fact that the only difference between *kakong-hata* and [*kakong cal hata*] is the one caused by the (non-)existence of *cal*. Under that system, while the former is a lexical item listed in the dictionary, the latter is a phrase constructed on the basis of syntactic mechanisms.

3   Sense Distinctions

Once we have identified the head words of a dictionary, we are in a position to deal with the meanings of words, i.e. the senses of words. Current dictionaries have the following problems regarding the definition of word senses (Atkins & Levin 1991, Ravin & Leacock 2000: 1-2). Firstly, the number of senses and the organization of senses (senses vs. sub-senses) are not the same or even similar. Secondly, the words used to define headwords are themselves polysemous. Thirdly, there are cases where a word used in a specific context cannot be mapped into any definition in the dictionary. In addition to these problems, we found out that many senses are unduly specified in Korean dictionaries, including *Yonsei Korean Dictionary* (Chae 2008). This over-specification of senses is mainly due to the influence of the complements and/or modifiers of the head word in question.

In the face of these problems, we need a set of pre-defined criteria to carve the meanings of words into different senses objectively and systematically. Some words have only one sense, i.e. monosemous, and many other words have more than one sense, i.e. polysemous. We need to consider some important issues before we try to identify word senses. We need to clarity, for example, the distinction between homonymy and polysemy, and between polysemy and indeterminacy/vagueness (Ravin & Leacock 2000: 2-6).

Homographs are a group of words which have the same string of letters but are not related etymologically and, hence, have different meanings. On the other hand, polysemes have the same etymological source, and, hence, are related semantically. However, the distinction is not always clear because the etymologically related meanings of a word can, over time, become so different that the original semantic relation can be obscured.

A more difficult task is to determine whether differences in meaning are due to multiple senses of a word or are realizations of a single sense. There have been proposed some diagnostic tests for the task: logical tests, linguistic tests, definitional tests, etc. None of these are satisfactory, but they are useful (to some degree). Let us consider the gender difference latent in the word *child*. Let us try to decide whether the meanings of 'male child' and 'female child' are manifestations of two senses or of a single sense. As we will see shortly, all the tests show that *child* is a single-sense word.

According to the logical test, the word concerned is polysemous "if an assertion involving a word can be both true and false of the same referent."

(11) The Logical Test
    a. The feather is light and not light.
    b. #I met not a child but a child.

As the feather is both 'light' and 'not light' at the same time, the word *light* can be judged to be polysemous. On the other hand, if a person is a 'child,' it cannot be a 'non-child.' Hence, the gender difference in *child* cannot be regarded as two separate senses. The linguistic test is "a linguistic constraint on using multiple senses in a single usage of a polysemous word."

(12) The Linguistic Test
    a. #Arthur and his driving license <u>expired</u> last Thursday.
    b. Mary and Tom are still <u>children</u>.

Sentence (a) is bizarre, i.e. "zeugmatic" because the reading of *expire* required by *Arthur* and that required by *his driving license* are different senses. If an expression in such context as in (a) leads to a zeugma, it indicates that the word in question is polysemous. As the word *child* in (b) does not lead to a zeugma, we can assume that it is a monosemous word. The definitional tes says that "a word is polysemous if more than a single definition is needed to account for its meaning."

(13) The Definitional Test
    a. *Newspaper*: ... a publication ..., ... an organization ...
    b. A *child* is a human being who is not yet an adult. (*Collins COBUILD Dictionary*)

If we are going to treat the polysemous word *newspaper* as a single-sense word, it would have to be defined as in (a). On the other hand, we don't have to use an expression like *a male ... or a female ...* in defining *child*, as we can see in (b).

    Not all sense units show the same degree of autonomy (Croft & Cruse 2004). Sense units are usually delimited by "full sense boundaries" and show the property of antagonism. Two antagonistic units are "mutually exclusive as foci of attention" (p. 112). However, there are some sense units which resemble full senses in many respects, but do not show antagonism (p. 115). Major subtypes of these sub-sense units are "facets" and "microsenses" (p. 116). Facets are "units that have a significant degree of autonomy, but can be unified to form a global Gestalt." Microsenses are "units that have a significant degree of autonomy, but can be unified into a superordinate category." The word *bank* in the 'financial' sense has facets of [PREMISES], [PERSONNEL] and [INSTITUTION]. As an example of the latter subtype, *knife* has not only a hyperonymic reading but also several hyponymous readings, including cutlery, weapon and (garden) tool readings. We need to pay attention to these sub-sense units as well as full sense units in identifying the senses of words (cf. the granularity issue).

4   Basic Units of Ontologies

The ontology is a hierarchical structure of some semantic units. Some scholars argue that the basic units have to be word senses. In this approach, an ontology is basically a word net, a net of word senses like WordNet. The ontology here is language dependent and inseparable from the word senses of a particular language. Most of all, we cannot use the ontology to figure out the similarities and differences among word senses in one or more languages (cf. Mahesh (1996: 49) and Hirst (2004: 6/14) for other problems).
    Many scholars, on the other hand, argue that the basic units of ontologies have to be (simple and/or complex) concepts rather than senses. A controversy in this approach is on the structural nature of the concepts. Scholars like Wierzbicka assume that only conceptual primitives can be

the building blocks and posits only 50-60 semantic primitives (Goddard 1998: 58). Many scholars, however, assume that not only simple concepts but also complex concepts can be the building blocks. Mahesh (1996: 49) provides a practical guideline to decide on the conceptual units: "… strongly discourages direct encoding of word senses as ontological concepts and at the same time constrains the developers from getting bogged down in unending decompositions of word meanings into deep underlying concepts and conceptual relations. ... not to decompose complex events or objects unless we see a practical need from a problem in analyzing an actual text."

In this section, we will provide some pieces of evidence which show that the basic units of ontologies should be some kind of conceptual units rather than word senses. Firstly, there are some words which, although they have disjunctions in their definitions, cannot be regarded as polysemous (Cruse 2000: 34).

(14) a. *Princess*: 'female child of monarch' or 'wife of male child of monarch'
     b. *Brother-in-law*: 'spouse's brother' or 'sister's husband'

As each of these monosemous words contains two separate concepts connected with the conjunction *or*, we can clearly see that the word senses can be broken down into conceptual units. As corresponding words in other languages do not necessarily have the same set of concepts connected by the conjunction, it would be impossible to compare them under the word sense approach. Secondly, as we saw in section 3, the facets of a word are not separate (full) senses. However, for example, the facets of *book*, [TOME] and [TEXT], are "of distinct ontological types" (Croft & Cruse 2004: 122). Thirdly, it is not clear how we can deal with color terms if we are going to assume that word senses are the building blocks of ontologies. Actually color terms cannot be defined with reference to genus and differentia. We have to resort to some conceptual units like their hue, value and chroma.
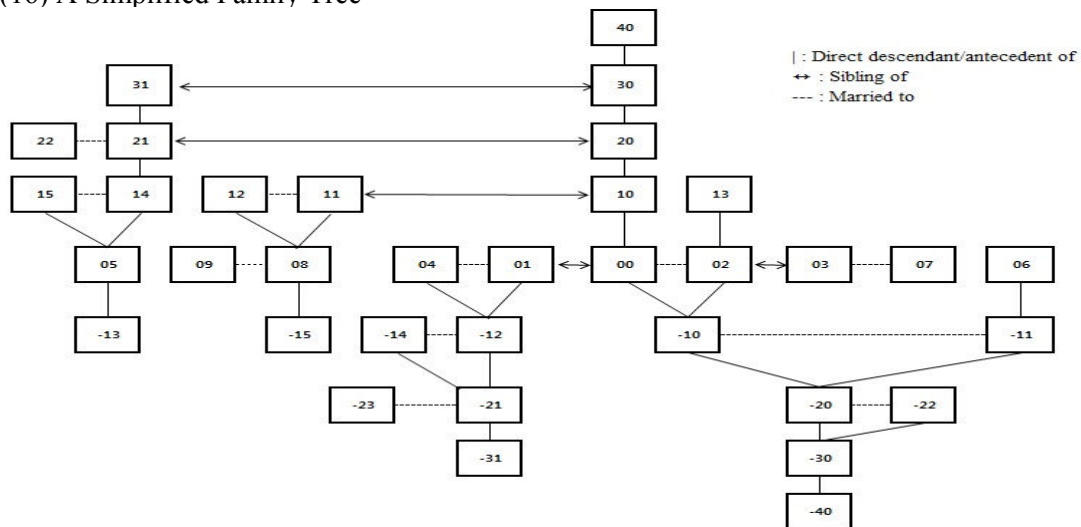
Kinship terms like those in (14) provide strong evidence for the usefulness of some conceptual units which may not be directly related to the senses of the words concerned. We have provided an analysis of Korean, English, Japanese and Chinese kinship terms, under an ontological framework (Baik & Chae 2010a, 2010c; Baik & Chae (this volume)). In the remainder of this section, we will sketch the framework and see how it works with reference to Korean and English kinship terms (refer to Baik & Chae (this volume) for Japanese and Chinese kinship terms).

The framework consists of a simplified family tree and some features. Firstly, the family tree implements some important properties of various kinship systems. Basically, the tree contains three different types of kinship relationships:

(15)   a. ─ ：Direct descendant/antecedent of (e.g., son ─ father)

       b. ↔ ：Sibling of (e.g., father ↔ father's female sibling)

       c. ---：Married to (e.g., father --- mother)

The family tree, incorporating these relations, can be represented as follows:

(16) A Simplified Family Tree

| : Direct descendant/antecedent of
↔ : Sibling of
--- : Married to

[Family tree diagram with numbered nodes: 40; 31 ↔ 30; 22---21 ↔ 20; 15---14, 12---11 ↔ 10, 13; 05, 09---08, 04---01 ↔ 00---02 ↔ 03---07, 06; -13, -15, -14---12, -10---11; -23---21, -20---22; -31, -30; -40]

The ego has the number "00" and the other nodes has a(n arbitrary) number. Some pairs of the nodes are connected to each other in one of the three relations represented by the symbols " | ," "↔" and "---."

Together with the family tree in (16), we use features to represent additional information on the nodes of the tree. The features and their values are as follows:

(17) a. SEX: {M(ale)}, {F(emale)}
    b. AGE: {O(lder-than)}, {Y(ounger-than)}
    c. ORDER: {F(irs)t}, {Sec(ond)}, {L(as)t}

Among these features, SEX and AGE have two values. The feature SEX divides the referents of kinship terms into males and females. The feature AGE shows whether the referent is 'older than' or 'younger than' the ego. This feature is very useful in defining Korean kinship terms, because most of them are sensitive to the relative age of the ego and the addressee. The feature ORDER is used when the referent concerned has a special status whether it is the first, the second or the last one among the siblings.

Kinship terms are represented as ordered n-tuples of the following, within the framework introduced above:

(18) <a, …, n>

The first element, *a*, denotes the 'ego' and the last one, *n*, denotes the 'addressee.' In between these two elements appear all the elements representing the nodes between the ego node and the addressee node in the tree. In addition, each element of the n-tuple can have SEX, AGE and/or ORDER features. For example, the term *oyhalmeni* 'maternal grandmother' in Korean is represented as <00, 10[SEX: F], 20[SEX: F]>. Under this representation, it is interpreted as 'ego's mother's mother,' which fits with our intuition.

Baik & Chae (2010c) provide an ontological analysis of Korean and English kinship terms. We extracted about 200 Korean kinship terms from *Yonsei Korean Dictionary* and 50 English Kinship terms from *LONGMAN Dictionary of Contemporary English* (LDOCE). Both of these dictionaries contain around 45,000 lexical entries. Focusing on each sense of the kinship terms, we considered which nodes the ego and the addressee of the sense belong to in the family tree, and checked whether these nodes and those in between them need to be specified with any

features. Then, we encoded each sense of the terms into the n-tuple format. Some of the analyses are shown below:

Analyses of some Korean and English kinship terms

Kinship Terms		Notations in the n-tuple format
Korean	English	
sonnye	*granddaughter*	<00, -10, -20[SEX:F]>
emeni/mochin	*mother*	<00, 10[SEX:F]>
apeci/pwu	*father/dad*	<00, 10[SEX:M]>
atul	*son*	<00, -10[SEX:M]>
ttal	*daughter*	<00, -10[SEX:F]>
acwumeni	*aunt*	<00, 10, 11[SEX:F]>
namphyen	*husband*	<00[SEX:F], 02[SEX:M]>
anay	*wife*	<00[SEX:M], 02[SEX:F]>
halapeci	*grandfather*	<00, 10, 20[SEX:M]>
myenwuli	*daughter-in-law*	<00, -10[SEX:M], -11[SEX:F]>
	sister	<00, 01[SEX:F]>
	brother	<00, 01[SEX:M]>
nwuitongsayng		<00[SEX:M], 01[SEX:F, AGE:Y]>
oppa/orapwi		<00[SEX:F], 01[SEX:M, AGE:O]>
	sister-in-law-1	<00, 02 03[SEX:F]>
	sister-in-law-2	<00, 01[SEX:M], 04[SEX:F]>
	brother-in-law-1	<00, 02, 03[SEX:M]>
	Brother-in-law-2	<00, 01[SEX:F], 04[SEX:M]>
checey		<00[SEX:M], 02[SEX:F], 03[SEX:F, AGE:Y]>
kyeyswu		<00[SEX:M], 01[SEX:M], 04[SEX:F]>
chenam		<00[SEX:M, 02[SEX:F], 03[SEX:M]>
maypwu		<00[SEX:M], 01[SEX:F, AGE:O], 04[SEX:M]>
cangson		<00, -10[SEX:M, ORDER:Ft], -20[SEX:M, ORDER:Ft]>
tangcil		<00[SEX:M], 10[SEX:M], 20[SEX:M], 21[SEX:M], 14[SEX:M], 05[SEX:M], -13[SEX:M]>

5   Conclusion

In this paper, we have examined basic units of dictionaries and ontologies: head words, senses and concepts. Firstly, we have seen, on the basis of the morpho-syntactic status of the head words in a Korean dictionary, that many head words are actually phrases and that many elements which are assumed to be affixes are (dependent) words, i.e. clitics. Secondly, we have examined some issues related to the classification of word meanings into senses. In order to solve the problems of current dictionaries in dealing with senses, we need to have a pre-defined set of objective criteria. Lastly, we have seen some pieces of evidence which show that the building blocks of ontologies should be concepts rather than word senses. Especially, in the

case of color terms and kinship terms, we would not be able to do a systematic comparative study on their meanings if we do not employ a system of conceptual units.

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